The Effect of Fertilizer on Algae—A lesson in Nutrient Cycling - 15 points
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Research Question: How do excess nutrients affect the growth of algae?

Information: In a healthy ecosystem, nutrients cycle among primary producers, consumers, and decomposers. The growth of primary producers is limited by the availability of specific nutrients, called limiting factors, which are only available in small amounts in nature. Humans can intentionally increase the amount of nutrients in an ecosystem, for example, farmers may add fertilizer to the soil in which they grow crops. But the addition of nutrients to an ecosystem is not always planned or the planned alterations may have side effects to adjoining systems. For example, the runoff of water from the soil may carry these nutrients from the fertilizer to coastal waters or freshwater ponds/streams, etc. In this lab, you will observe what happens to algae (a primary producer) when excess nutrients are added to the water where the algae lives.

As primary producers, algae form a necessary base of the food web in the upper layers of the ocean and in freshwater lakes and ponds. The term algae is used to describe a range of organisms from large brown kelp found attached to rocks at the seashore to the tiny green algae found in fish tanks. Like other plants, green algae need nitrogen (N), phosphorus (P), and potassium (K) in order to grow (so do you by the way….there are common chemicals and elements found in living organisms and the environment in which we live!). All three nutrients must be available for the algae to thrive and reproduce.

Have you ever seen a pond with a thick, green layer of algae on its surface? This layer is a sign that the homeostasis of the ecosystem has been disturbed by the presence of too much nitrogen or phosphorus in the water. Fertilizers and animal waste contain these nutrients, which can be transferred to bodies of water when rainfall flows downhill from farms.

In this lab you will work with Chlorella, a type of algae that is commonly found in ponds and aquariums. You will compare the growth of Chlorella when nutrients are limited and when nutrients are abundant.

Pre-lab Questions:
1. What is the definition of a limiting nutrient?
2. Choose a product to test in the experiment- choice include miracle grow, happy frog, or others available
3. Why do farmers use fertilizer?
4. What are algae and what role do algae play in freshwater ecosystem?
5. What nutrients do farmers and ranchers contribute to algae growth.

Mini Report format
Title: include independent and dependent variables.
Experimental Design: statement of hypothesis
*Background information – big picture about farming, ranching and excess nutrients and the impact to the ecosystem.
*Independent variable and *dependent variable
*Experimental Group and *Control group
* Prediction
**Materials:** test tubes, test-tube rack, black sharpie, dropper pipettes, algae cultures, 25-mL graduated cylinder, spring water, plant food, cotton balls, grow light.

**Skills:** predict, compare, contrast, infer, data reporting and variable determination

**Safety:** Wear safety goggles and plastic gloves when handling cultures. If you have a glass test tube or cylinder, check for cracks or chips. Alert your teacher if you break an object. Wash your hands thoroughly with soap and water before leaving this lab. NO FOOD in the lab!!

**Procedure**

With your team, write an 8-step procedure for setting up your experiment. Be sure to include specific amounts, numbers, and details. YOU MUST HAVE YOUR PLAN APPROVED BEFORE STARTING YOUR EXPERIMENT!

Create a data table to record data for 4 days. Algae growth will be check approximately every 2 or 3 days. Remember a title for the data table and use a ruler.

**Tips:**
1. What will you add to your experimental group? What will be your control?
2. Use sharpies to label your control and experimental test tubes. Also, include your initials
3. Spring water contains no chlorine, fluorine or salts. Tap water is not safe for most pond organisms.
4. Test-tube racks can be placed under a grow light which will provide consistent light or by the windows which will provide inconsistent light.
5. Leave room to attach a graph

**Analyze and conclude – RESTATE the question within the answer- be thorough.**

1. Summarize your observations of the two test tubes over the four days. Also, include information provided from other group’s algae growth and Ms. Thennis.
2. How did the fertilizer affect the growth of the algae?
3. How could a thick later of algae on the surface of a pond affect producers that live on or near the bottom of the pond?
4. How could this layer affect the consumers on the top and the bottom of the pond?
5. How can farming and ranching influence water quality? What other ways can these practices influence water quality? How could these impacts be reduced, controlled, or eliminated?
6. What learning occurred in this lab? What concepts from lectures and textbook are important for this lab? (include at least 5 sentences)

Adapted from Miller and Levine; Biology Pearsons Science, 2010, Upper Saddle River, New York City.